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NO. 4, 2018



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Bedrock Revealed as Major Nitrogen Source

By Ralph Birch

A study recently published in *Science* reveals that nitrogen actually seeps into the soil from bedrock, a source that has been long overlooked.

The theory that nearly all of the plant-required nitrogen comes from the atmosphere (and enters the soil via microbes or dissolved in rain) has been commonly accepted. Not only does this finding change our ideas about plant growth and the Earth's nitrogen life cycle, it may alter climate change models.

"The research community never thought to look at the rocks," said Benjamin Houlton, a global ecologist at the University of California, Davis and the lead author of the study.

Bigger and Greener

This new information suggests that plants in certain areas may be able to grow larger and at a faster rate than originally thought. Bigger plants are able to absorb more carbon dioxide from the air.

As temperatures rise across the globe, calculating how much carbon dioxide plants consume is becoming increasingly important. The exact amount of absorption remains uncertain, but

Houlton notes that plants could provide more of a cushion when it comes to storing carbon pollution.

Previous research assessed the balance between how much nitrogen in sediments reaches the mantle (the layer below the earth's crust) and the amount from gases released into the atmosphere by volcanoes (which is 78 percent nitrogen).

Learning from the Past

Starting in the 1970s, a handful of studies showed that several types of sedimentary rock contain nitrogen from dead plants, algae, and animals that fell to the sea floor. A few studies suggested the element might leach into soil in certain places, but scientists did not follow up on these findings. As a result, the amount of nitrogen in bedrock was thought to be insignificant.

"It wasn't entering into the paradigm of how we think the nitrogen cycle works," Houlton said.

Houlton and his colleagues published a study in a 2011 issue of *Nature* that found soil in forests that grow above sedimentary rock in parts of California contain 50 percent more nitrogen than in areas with overlying igneous (volcanic) rock. They also found 42 percent more nitrogen in trees growing over sedimentary bedrock.

The new study used California as a model geologic system because the state contains most of the planet's rock types. Houlton and his team measured nitrogen levels in nearly 1,000 Californian samples and in others from around the world. With the results, they developed a computer model to calculate how quickly rocks break down and release nitrogen into the soil.

"Our study helps to resolve that gap between what the observations were saying and what the models were predicting," Houlton said.

Organometallics: Vital and Versatile Compounds

The Importance and Versatility of Organometallic Chemistry

Organometallics are versatile and widely used compounds that play a vital role in chemical research and industrial applications.

Organometallic compounds contain at least one bond between a carbon atom and the atom of a metal element. The electropositive character of their metals makes organometallic compounds highly reactive and vital to many chemical syntheses. This broad category includes chemicals with significantly different physical and chemical properties, which are used as homogeneous catalysts, stoichiometric reagents, and in many other applications.

Early Organometallic Reagents

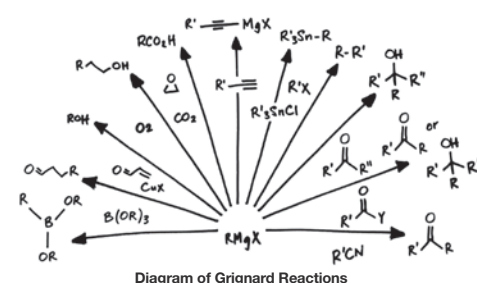
One of the first organometallics to be identified was diethylzinc, discovered in 1848 by the British chemist Edward Frankland. By combining zinc metal with ethyl iodide, Frankland produced a colorless liquid that reacted violently with water and ignited upon contact with air.

Fifty years after Frankland's discovery, organometallic chemistry and its

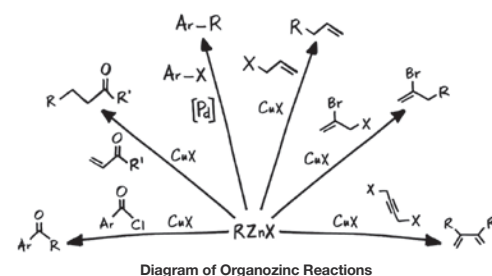
practitioners were still creating and identifying compounds. French chemist Victor Grignard developed the novel organomagnesium reagents in the 1900s, which are still among the most important in modern chemistry. Now named Grignard reagents, their formula is RMgX , where X is a halogen and R is an alkyl or aryl group. Grignard was awarded the 1912 Nobel Prize in Chemistry for his pioneering work.

Applications of Grignard and Organozinc Reagents

A significant use of organometallic compounds is in the formation of new carbon-carbon bonds. Both Grignard reagents and organozincs (specifically organozinc halides) are an excellent source of nucleophilic carbon atoms because of the polarity differences within the metal-carbon bond. These nucleophilic carbon atoms react with electrophilic carbon to produce a new carbon-carbon bond, which is a very convenient method of assembling compounds from smaller precursor molecules.



In these reactions, the organozincs are less reactive than Grignard reagents. This is an advantage for certain sensitive reactions that require higher functional group tolerance, but this low reactivity means that organozincs often need the help of additives or catalysts.



Because Grignard and organozinc reagents are used in highly sensitive reactions, the quality of organometallic reagents is crucial. Inferior reagents may cause incomplete or failed reactions, which reduces product yields. Selecting appropriate reagents for complex stereochemical syntheses also minimizes the potential for racemic mixtures.

Grignard and organozinc reagents from the Acros Organics and Alfa Aesar brands provide consistent stereochemical and high-yield results to help you reach your goals.

Other Organometallic Reagents

In addition to Grignard reagents and organozinc compounds, organolithium, organoaluminum, and organotin reagents have proven useful for a number of applications.

During the 1950s, German chemist Karl Ziegler reported that a combination of titanium tetrachloride [TiCl_4] and organoaluminum chloride [$\text{Al}(\text{C}_2\text{H}_5)_2\text{Cl}$]

formed an excellent catalyst for producing polyethylene. Later, Italian scientist Giulio Natta used titanium (III) chloride [$\alpha\text{-TiCl}_3$] in combination with triethylaluminum [$\text{Al}(\text{C}_2\text{H}_5)_3$] to produce the first crystalline isotactic polypropylene. These organometallics became known as Ziegler-Natta catalysts and are still used in the commercial manufacture of various polyolefins. Ziegler and Natta were awarded the 1963 Nobel Prize in Chemistry for their organic chemistry contributions.

Ziegler, along with Georg Wittig and Henry Gilman, also pioneered the use of organolithium reagents as alternatives to Grignards. Organolithium reagents share many of the same characteristics, and can be used in the same reactions as Grignard reagents but react more quickly and produce greater yields.

Organometallic innovations continued throughout the 20th century, including these key developments:

- The Heck reaction showed that organopalladium catalysts can form intricate substituted alkenes

- Cyclobutadieneiron tricarbonyl compounds were discovered

- Roald Hoffmann and Kenichi Fukui won the 1981 Nobel Prize in Chemistry for the creation of the Woodward-Hoffman Rules, which predict the stereochemical outcomes of pericyclic reactions.

Unparalleled Reagent Options

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Ethylmagnesium bromide, 3M in diethyl ether*	925-90-6	AC34729
Ethynylmagnesium bromide, 0.5M in THF*	4301-14-8	AC43912
Isopropylmagnesium chloride, 2.0M in THF*	1068-55-9	AC21285
Methylmagnesium chloride, 3M (22 wt.%) in THF*	676-58-4	AC25256
Vinylmagnesium bromide, 0.7M in THF*	1826-67-1	AC20939
Alfa Aesar Organozinc Reagents		
2-Pyridylzinc bromide, 0.5M in THF**	218777-23-2	AAH58544-AD
Isopropylzinc bromide, 0.5M in THF**	77047-87-1	AAH58536-AD
3-(Ethoxycarbonyl)propylzinc bromide, 0.5M in THF**	131379-39-0	AAH58023-AD
Benzylzinc bromide, 0.5M in THF**	62673-31-8	AAH58014-AD
Allylzinc bromide, 0.5M in THF**	18925-10-5	AAH58012-AD
Cyclopropylzinc bromide, 0.5M in THF**	126403-68-7	AAH58008-AD
Additional Organometallics		
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Alfa Aesar Titanium(IV) isopropoxide, 97+%	546-68-9	AA077115
Alfa Aesar Tantalum(V) ethoxide, 99.999% (metals basis), Nb <100ppm	6074-84-6	AA014643
Acros Organics Diisobutylaluminum hydride, 1.2M (20 wt%) solution in toluene*	1191-15-7	AC20108

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Water, Purified, USP/EP Grade	9190-5	20L
Sodium Chloride, 0.9% (w/v), in Water (Isotonic Saline)	7210-1	4L 4 x 4L/Case
Starch Indicator, 1% (w/v) in Water, Mercury Free, for Iodometric Titrations	8050-32	1L
Silver Nitrate, 0.100N	70001	4L
ProteoSpec Formic Acid Ampules, LC/MS Grade	RMB11202101	10mL
Potassium Chloride Conductivity Standard, 1ms/cm at 25°C	588801-32	1L

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Lessons from an Abandoned Lab

By Kylie Wolfe

We tend to think of science as something that's always on an upward trajectory, inspiring progress and driving innovation. But some scientific centers, like the Amani Hill Research Station in Tanzania, have struggled to sustain their research efforts.

Throughout the 1950s, this lab was widely respected as a source of groundbreaking malaria research. Now vacant, it sits frozen in time. Stacks of paper with handwritten data sit abandoned on shelves, lab equipment on benches, and expired chemicals in cabinets. Even old diagrams of mosquitos have been left behind.

A Glimpse into the Past

Once a hub for scientific excellence in the jungles of East Africa, Amani employed 100 researchers searching for solutions to their country's health problems. With this goal in mind, they hoped to pave the path to a bright future for African-led research teams — not only to inspire new ideas in science, but also to establish financial freedom and racial equality.

Even though the diseases they studied were more prominent in the lowlands, the facility was located at a high altitude in a remote area. This created a community large enough to sustain a post office, provide access to shopping, movies, and fresh milk, and offer recreational activities.

By 1977, foreign funding dried up as a result of political conflict. Labs like Amani started to become less of a focus, and throughout the 1990s, young researchers decided to travel abroad for positions in Western-led labs. As the Amani community fell apart and it became more

costly to travel to study sites, they moved the lab two hours downhill. Now, only a small staff maintains the old location.

Insight for the Future

The story of Amani is not unusual, and it serves as a useful warning about the future of basic research. As government budget cuts threaten funding, private businesses are stepping in and pressuring researchers to support their corporate agendas in place of the researchers' own. More and more labs are shifting away from solving long-term problems of inequality and climate change to focusing on “quick-fix” areas of study to avoid sacrificing their sources of funding.

As Paul Wenzel Geissler, a professor of social anthropology at the University of Oslo, says, “It's entirely correct to look at places like Amani as a future for us all, if we allow infrastructure and basic research to be neglected and devalued.”

The Fate of Amani

Research in Africa is starting to boom again, but not without struggle. The government provides funding for employee salaries, but nothing beyond that. Increasingly, African labs rely on international organizations, universities, and philanthropy, but those sources often turn their attention to labs in the Western world instead.

In 2016, the Tanzanian Minister of Health announced her support to restore the Amani lab. It could become a university campus, a training center, or even a museum. But, for now, its exact fate remains uncertain.

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P10L	Red	1	1 to 10µL	FA10002M	FA10002MG
P20L	Yellow	1	2 to 20µL	FA10003M	FA10003MG
P100L	Salmon	1	10 to 100µL	FA10004M	FA10004MG
P200L	Yellow	1	20 to 200µL	FA10005M	FA10005MG
P1000L	Blue	1	100 to 1000µL	FA10006M	FA10006MG
P5000L	Purple	1	500 to 5000µL	FA10007	FA10007G
P10mL	Blue	1	1 to 10mL	FA10008	FA10008G
Multichannel					
P8x10L	Red	8	0.5 to 10µL	FA10013	FA10013G
P8x20L	White	8	2 to 20µL	FA10009	FA10009G
P8x200L	Yellow	8	20 to 200µL	FA10011	FA10011G
P8x300L	Green	8	20 to 300µL	FA10015	FA10015G
P12x10L	Red	12	0.5 to 10µL	FA10014	FA10014G
P12x20L	White	12	2 to 20µL	FA10010	FA10010G
P12x200L	Yellow	12	20 to 200µL	FA10012	FA10012G
P12x300L	Green	12	20 to 300µL	FA10016	FA10016G



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TILT Light Shields, White Silicone Sleeves, Includes Four GL 56 Tags	Tag Colors: Orange, Yellow, Blue, Purple	292435601	14-209-152	4/Pack
Duran GL 56 Bottle Tags, For ID or to Secure Light Shields, Silicone	Color: Orange	292435626	14-209-153	20/Pack
	Color: Yellow	292435634	14-209-154	20/Pack
	Color: Blue	292435659	14-209-155	20/Pack
	Color: Purple	292435667	14-209-156	20/Pack
Duran GL 45 Adaptor, for Bottle Top Filters	White PTFE	291195601	14-209-157	Each
TILT Self-Adhesive Identification Labels	White, Dia.: 40mm	294015604	14-209-158	60/Pack
TILT GL 56 Screw Caps	White PP	292295602	14-209-159	10/Pack
TILT Bottle Top Vacuum Filtration Units, 90mm, PES, Sterile, 500mL	Pore Size: 0.1µm	292702818	14-209-160	12/Case
	Pore Size: 0.2µm	292702826	14-209-161	12/Case
	Pore Size: 0.45µm	292702842	14-209-162	12/Case

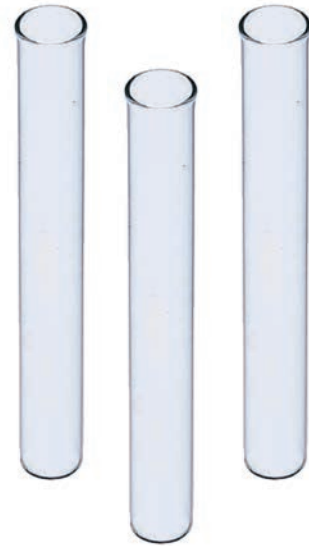
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15 x 85mm	13mL	14-961-28	1,000/Case
16 x 100mm	15mL	14-961-29	1,000/Case
16 x 125mm	19mL	14-961-30	1,000/Case
16 x 150mm	23mL	14-961-31	1,000/Case
18 x 150mm	28mL	14-961-32	500/Case
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		Orange	14-957-20D	1,000/Case
		Blue	14-957-20E	1,000/Case
12 x 75mm	6mL	White	14-957-22A	1,000/Case
		Yellow	14-957-22B	1,000/Case
		Green	14-957-22C	1,000/Case
		Orange	14-957-22D	1,000/Case
13 x 100mm	10mL	Blue	14-957-22E	1,000/Case
		White	14-957-24A	1,000/Case
		Yellow	14-957-24B	1,000/Case
		Green	14-957-24C	1,000/Case
16 x 100mm	15mL	Orange	14-957-24D	1,000/Case
		Blue	14-957-24E	1,000/Case
		White	14-957-26A	1,000/Case
		Yellow	14-957-26B	1,000/Case
		Green	14-957-26C	1,000/Case
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Fisherbrand Traceable Datalogging Hygrometers and Barometers

Easily record data and comply with regulatory requirements by using Fisherbrand Traceable Excursion-Trac and Memory-Loc Hygrometers and Barometers. These digital dataloggers help you track temperature, humidity, and barometric pressure readings and download data to document and analyze your results.

The memory of the Excursion-Trac Meters can be cleared, but only after the data has been downloaded to a USB drive (CSV file format). The Memory-Loc Meter, intended for use in 21 CFR 11 environments, holds data permanently — the unit memory can be downloaded but cannot be cleared or changed.

- Data transfer to a USB drive — no software needed
- User-defined time intervals
- LCD display
- Choice of temperature scales (F/C)
- Visual/audible alarm



Datalogging Hygrometers

Description	Data Overwrite?	Range	Cat. No.
Excursion-Trac Hygrometer	Yes	<ul style="list-style-type: none"> • Humidity: 0 to 95% RH (non-condensing) • Ambient Temperature: 32 to 145°F (0 to 65°C) 	15-079-665
Memory-Loc Hygrometer	No	<ul style="list-style-type: none"> • External Temperature: -4 to 158°F (-20 to 70°C) 	15-079-667

Datalogging Barometers

Description	Data Overwrite?	Range	Cat. No.
Excursion-Trac Barometer	Yes	<ul style="list-style-type: none"> • Barometric Pressure: 500 to 1030mbar • Humidity: 0 to 95% RH (non-condensing) 	15-079-666
Memory-Loc Barometer	No	<ul style="list-style-type: none"> • Temperature: 32 to 145°F (0 to 65°C) 	15-079-668

All meters include a universal AC adaptor, stand, hook-and-loop fastener, magnetic strips, wall mount, batteries, and Traceable certificate.

Oil Free, Low Maintenance

Fisher Scientific MaximaDry Pumps

No more downtime to add or change pump oil. Enjoy quiet, reliable operation without the mess of oil or the operating costs and environmental problems associated with water aspirators.

- **Corrosion-resistant materials** — The thick, solid PTFE resin heads will not peel or corrode when exposed to most aggressive solvents and the sturdy FFPM valve system handles occasional liquids without degrading performance
- **Quick and easy setup** — Be up and running in minutes; everything connects together without tools or fittings, just add 3/8 in. I.D. tubing
- **Compact, stylish design** — For convenient access, your MaximaDry Oil-Free Pump fits easily where you need it — on your bench or inside your fume hood



13-880 Series

Head Configuration	Capacity	Vacuum	Pressure	Motor	Dimensions (L x W x H)	Cat. No.
Single Stage	20L/min.	75 torr	15psig	1/6 hp	13 x 6.5 x 8.5 in.	13-880-14
Single Stage	40L/min.	65 torr	15psig	1/6 hp	13 x 6.5 x 8.5 in.	13-880-16
Two Stage	20L/min.	6 torr	15psig	1/6 hp	15 x 6.5 x 8.5 in.	13-880-18
Two Stage	35L/min.	6 torr	15psig	1/3 hp	16 x 7 x 9 in.	13-880-20
Two Stage	35L/min.	1.5 torr	15psig	1/3 hp	16 x 7 x 9 in.	13-880-22

Versatile Seating

Fisherbrand Laboratory and Office Chairs

Choose Fisherbrand seating, available in a wide variety of styles and materials for your laboratory needs.



Description	Height	Feet	Footrest	Armrests	Material (Color)	Cat. No.
Wooden Laboratory Chair	Medium Bench (22 to 32 in.)	Glides	Yes	No	Wood (Natural)	14-359-328
Wooden Laboratory Chair	Desk (16 to 21 in.)	Glides	No	No	Wood (Natural)	14-359-316
Modern Mesh Office Chair	Desk (16 to 21 in.)	Casters	No	3D Adjustable	Mesh (Black)	14-400-447
Medium-Form Laboratory Chair	Medium Bench (21 to 28 in.)	Casters	Yes	No	Vinyl (Gray)	14-359-442
High-Form Laboratory Chair	Medium Bench (24.5 to 33.5 in.)	Casters	No	No	Polyurethane (Black)	14-359-800
High-Form Laboratory Chair	High Bench (26 to 35 in.)	Casters	Yes	Adjustable	Fabric (Burgundy)	14-360-485

Baths for Cleaning, Mixing, and Degassing

Fisherbrand Ultrasonic Cleaners

- Maximum versatility — choose frequency, power level, time, temperature, and ultrasonic mode
- Products in stock and ready to ship
- Six tank sizes: 0.7 to 7.3 gallons
- Compatible with most cleaning solutions
- Accessories sold separately



Model	Capacity	Cat. No.
FB-11201	0.7 gal.	FB11201
FB-11203	1.5 gal.	FB11203
FB-11205	1.8 gal.	FB11205
FB-11207	3.3 gal.	FB11207
FB-11209	4.75 gal.	FB11209
FB-11211	7.3 gal.	FB11211

Rapid Tissue Homogenization

Fisherbrand Bead Mills and Tubes

Fisherbrand Bead Mills and Tubes are designed for grinding, lysing, and homogenizing biological samples in preparation for molecular extraction. Their unique tube carriage motion, coupled with tissue-specific abrasive materials, helps to achieve complete homogenates for DNA/RNA extraction, enzyme isolation, and protein purification.

Bead Mill 4 Homogenizer

- Simultaneously processes 4 x 0.5mL, 4 x 1.5mL, 4 x 2mL, or 1 x 7mL samples
- Offers everything from gentle mixing to high-force homogenization
- Saves space with a small footprint
- Includes Bead Mill 4 Motor Drive; integrated 0.5mL, 1.5mL, and 2mL tube carriage; 7mL tube carriage; tool kit; and instruction manual



Bead Mill 24 Homogenizer

- Simultaneously homogenizes up to 24 x 0.5mL or 24 x 2mL tubes
- Saves space with its small footprint
- Includes convenient front-loading tube holder
- Offers non-stop processing with no cooldown required between runs
- Features run times from 1 to 99 seconds



Bead Mill Tubes

- Disposable, helping to reduce the risk of cross-contamination
- Reinforced to prevent breaking
- Paired with screw caps
- Free of RNase and DNase



Fisherbrand Bead Mills

Description	Cat. No.
Bead Mill 4 Homogenizer	15-340-164
Bead Mill 24 Homogenizer	15-340-163

Fisherbrand Bead Mill Tubes

Application	Capacity	Bead Size (Material)	Cat. No.	Quantity
Hard Tissue Grinding	2mL	2.4mm (Metal)	15-340-151	50/Pack
Soft Tissue Homogenizing	2mL	1.4mm (Ceramic)	15-340-153	50/Pack
Hard Tissue Homogenizing	2mL	2.8mm (Ceramic)	15-340-154	50/Pack
Hard Tissue Grinding	7mL	2.4mm (Metal)	15-340-155	50/Pack
Soft Tissue Homogenizing	7mL	1.4mm (Ceramic)	15-340-156	50/Pack
Hard Tissue Homogenizing	7mL	2.8mm (Ceramic)	15-340-157	50/Pack

Works Instantly

Fisherbrand RNase Displace Decontaminant

Remove RNase and unwanted DNA with Fisherbrand RNase Displace Decontaminant.

- For use on glass, plastic, metal, and ceramic surfaces
- Totally rinsable
- Phosphate free
- Safely disposable



Description	Mfr. No.	Cat. No.
RNase Displace, 8 oz. Bottle	1408	04-355-137
RNase Displace, 32 oz. Bottle	1432	04-355-138
RNase Displace, 1 gal. Jug	1401	04-355-136

Complete Your Cell Culture Workflow

Fisherbrand Cell Culture Plates

The Fisherbrand collection now includes surface-treated plates to support your tissue culture needs. Made from 100% virgin polystyrene, they are manufactured in a Class 100,000 cleanroom, treated to enhance cell attachment, and gamma sterilized to an SAL of 10⁻⁶.

- Your choice of 4, 6, 12, 24, 48, or 96 wells
- Vented lids with condensation rings
- Non-pyrogenic, non-cytotoxic; DNase and RNase free; BSE and TSE free
- Conform with USP Class VI and ISO 10993-5 standards
- Lot numbers appear on each piece, inner packaging, and case labels
- Individually wrapped (paper/plastic blister)

No. of Wells	Well Volume	Growth Area	Well Shape	Cat. No.
4	2mL	2cm ²	Flat	FB012926
6	17mL	9.5cm ²	Flat	FB012927
12	7mL	4cm ²	Flat	FB012928
24	3.5mL	2cm ²	Flat	FB012929
48	1.5mL	0.8cm ²	Flat	FB012930
96	0.4mL	0.3cm ²	Flat	FB012931
96	0.3mL	0.3cm ²	Round	FB012932



Visit fishersci.com/fbcellculture or fishersci.ca/fbcellculture to shop all Fisherbrand cell culture products.

Zebra Finches Teach Us About Learning

By Christina Phillis

The zebra finch may be the epitome of the idiom: You can't teach an old dog new tricks. Some zebra finches don't retain the ability to learn new songs as they get older, but the reasons are not what you might expect.

Surprisingly, finches lose this ability only if they were tutored in their youth. Finches that weren't taught specific songs are still able to learn. This peculiarity was the focus of a recent study, which discovered that experience can cause changes to the structure of genomic DNA that consequently affects the ability to learn.

What's in a Song?

The zebra finch is commonly found in Australia, and only the males can learn and memorize songs. They learn a single song from an adult during the critical period of 30 to 65 days after hatching. That song forms the basis for a new, unique song that they create and use for the remainder of their lives. Once zebra finches pass that early critical period, tutored juvenile finches lose their ability to learn new songs and untutored finches, oddly, retain their learning abilities.

To test their hypothesis, a team led by Sarah London, an assistant professor in the Department of Psychology at the University of Chicago, isolated a set of male juvenile finches during their critical periods. A second set of birds received tutoring during the same period.

Researchers witnessed different epigenetic changes in the brains of tutored versus isolated finches, which resulted in modifications of the structural properties

of their genomic DNA. This indicates a link between the epigenetic process that allows experience to trigger gene expression, and the gene expression that is required for tutored song memorization.

The results showed that regulatory factors known to have a role in learning and memory are overrepresented in the genes of the isolated birds.

Technically Speaking

Behind all of these complex processes is the confirmed presence of a specific neural signal in the brains of juvenile zebra finches: the mechanistic Target of Rapamycin or mTOR cascade. When the birds hear a song, the mTOR cascade is activated.

"We had evidence from other lab studies that mTOR inhibition disrupted learning events, and we had evidence that its activation did also, but not a good comparison. We wanted to directly test both activation and inhibition side by side in the same experiment," London said.

The team analyzed the song patterns of adult tutors and their juvenile pupils using software designed for vocal comparison. When researchers enhanced or inhibited the mTOR activation, both actions caused a decrease in the bird's ability to mimic the adult song. When mTOR activation was modified, juvenile birds retained the ability to learn songs but could not reproduce entire song structures.

Future Implications

The results from this study may help us to

better understand early-life experiences and their effects on behavior and functions of the brain. mTOR regulates protein synthesis, an important factor in long-term memory formation, and mTOR-related disruptions are associated with autism and other memory-related conditions.

"In the last 5 to 10 years, there seems to be a convergence on the mTOR cascade as a common disrupted process in autism spectrum disorders. We are not investigating autism per se, but what got our attention was that the zebra finches model a similar kind of situation, where there's a developmental event that requires social interactions, and a communication behavior that is hard to study in rodents who don't typically learn vocalizations," said London.

Another potential application is using learning inhibition to prevent patients from forming long-term memories of trauma. Researchers also hope that the capabilities of disadvantaged children could be boosted if we had a better understanding of how young children learn.

From advancing children's abilities to demystifying complex neurological disorders, the results of this study open up a wide range of possibilities and once again prove that we never stop learning.

Technology and Education – Advancing Together

By Mae Pyer

Students are growing up with technology in their pockets and on their desks, giving them instant access to a world of information. This electronic evolution is not only changing the way they learn, but how teachers teach. Companies are creating personalized content that caters to students' needs, while providing instructors with critical feedback about progress and pace.

Enhancing Education

While technology is increasing educational opportunities, it is also changing the typical classroom dynamic. For centuries, teachers have stood at the front of the class instructing a room full of students sitting in rows. Although the format may still be the same, the roles are evolving. Teachers increasingly serve as guides, empowering students to work in small groups and lead their own discussions. These advances enable new methods of communication and collaboration, like joining a video call with classrooms in another part of the world or connecting

with a renowned speaker at a university across the country.

A New Era

Though some may consider technology to be a distraction, it provides opportunities to educate people anywhere in the world. In 2012, Harvard University and the Massachusetts Institute of Technology launched edX, an online platform offering free courses from highly regarded institutions. Pearson Education, which is also focused on being a source for global learning, has created personalized classes that provide instructors with access to information about student experiences. Programs like these are reinforcing the idea of an “anytime, anywhere” education for students and teachers alike.

DreamBox, a math software program that adapts to a student's skill level and pace, is actually replacing classic textbooks, giving students the individualized attention they need to be successful. The system records

information about learning and progress so that teachers can develop a better understanding of what teaching methods are most effective. These programs allow students to learn on their own in a way that is both enjoyable and unique.

More to Come

Currently, the United States Navy is testing an artificial intelligence program that provides students with one-on-one tutoring catered to individual learning styles. By enabling instructors to group students with similar skills, the program should allow students to learn more in shorter periods of time.

As technology evolves, companies will continue to create products that provide teachers with new tools designed to enhance the classroom experience. And as teachers adapt, they will help the field of education mature into new forms for the 21st century.



What to Consider When Selecting a CO₂ Incubator

When culturing primary and stem cells, incubation times with optimal conditions are critical to cell growth. Choose a CO₂ incubator with the right features for your application, including high-quality in-chamber sensors that accurately measure the true conditions your cells experience.

Frequently Asked Questions

Q: Does the location of the sensors in a CO₂ incubator affect my cultured cells?

A: Yes. Sensors should be exposed to the same conditions as your sensitive cells.

Some CO₂ incubators place the sensors outside the chamber, which creates a delay in response and may not reflect current conditions. However, external sensors are not exposed to the hot, humid, and slightly acidic conditions in the chamber and are not required to withstand high-temperature sterilization or chemical disinfectants.

Thermo Scientific CO₂ incubators feature temperature, CO₂, O₂, and humidity sensors inside the cell incubation chamber. The sensors can then react to the same conditions as the cells, provide accurate and quick responses, minimize delays, and eliminate the need for tubing and other supplies.

Q: What is a bypass loop?

A: A bypass loop is used to measure conditions inside an incubator using external rather than internal sensors. With this method, air from the chamber is pumped through a filter and tubing to the sensors, then returned to the chamber.

Because the air must be heated to maintain temperature and limit condensation, the conditions measured may differ from conditions in the chamber. Additionally, by-pass loops may introduce the risk of microbial contamination to the chamber — and to your cells.

Figure 1: Representation of a typical bypass loop.

The use of external sensors also requires a filter, tubing, pump, and separate heater.

Figure 2: All Thermo Scientific CO₂ incubators include high-quality in-chamber sensors to ensure that the measurements accurately reflect the internal conditions.

This also eliminates the need for the tubing, filters, pump, and heater. Examples include (A) a thermal conductivity CO₂ sensor with relative humidity compensation, (B) dual-temperature probes, and (C) a zirconium oxide O₂ sensor.

Q: What other features are important when selecting a CO₂ incubator?

A: Choose a CO₂ incubator that can provide an optimal growth environment, contamination control, and enhanced simplicity.

Consider:

- Chamber capacity
- Heating method (direct or water jacketed)
- Sensors, filters, and other condition-monitoring options and alarms
- Dimensions and space limitations (door swing direction, stackability)
- Internal configuration (glass viewing door, adjustable shelves)
- Construction materials (stainless-steel or copper interiors)
- Ease of operation, cleaning, and maintenance

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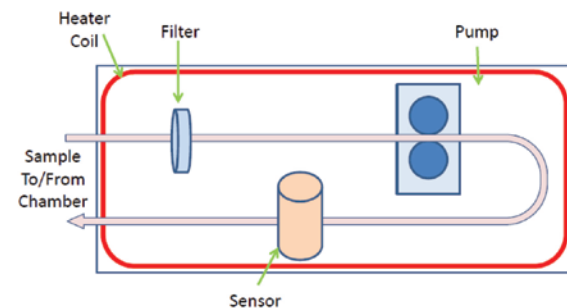


Figure 1

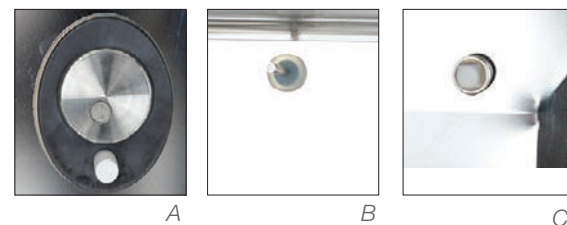


Figure 2

Help lock out contamination



for uninterrupted cell culture research

Because cell culture safety is essential to science

Thermo Scientific laboratory equipment and consumables are designed to help prevent contamination at every step in the cell culture workflow. Our extensive offering of high-quality solutions — including CO₂ incubators, biological safety cabinets, centrifuges, cold storage, filters, and plastics — gives you peace of mind to stay focused on achieving your research goals.

Visit fishersci.com to find out more.

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For customer service, call 1-800-234-7437
To fax an order, use 1-800-463-2996
To order online: fishersci.ca

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For long-term sample viability,



choose the company that stands the test of time.

When you store your samples in a -80°C freezer, you need to know that they are safe for a week, a month, a year, or even a decade. With a time-tested heritage in laboratory storage, bio-banking, and cell therapy, Thermo Fisher Scientific provides the peace of mind that your work will last.

The legacy of your work is forever supported by ours.
TSX Series Ultra-Low Temperature Freezers
 Essential to Science

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ThermoFisher
 SCIENTIFIC

For Corrosive Gases and Vapors

VACUUBRAND Oil-Free Chemistry Diaphragm Pumps

The VACUUBRAND MZ2C NT from BrandTech Scientific, Inc. offers superior vapor tolerance in a continuous, oil-free chemistry diaphragm pump. It combines high speed with 7mbar ultimate vacuum, and is ideal for evaporative applications such as rotary evaporators, vacuum ovens, and gel dryers.

- Fluoroplastic internal components for complete chemical resistance
- PTFE diaphragms for reliability and a life of over 15,000 operating hours
- Whisper-quiet, low-vibration operation, as well as vacuum filtration



Model	Ultimate Vacuum	Free Air Capacity at 60Hz	Mfr. No.	Cat. No.
MZ2C NT	7mbar	1.4 cfm	732303	13-688-915
MD1C	2mbar	0.9 cfm	696613	13-688-285
ME1C	100mbar	0.5 cfm	721103	13-688-811
ME2C NT	70mbar	1.4 cfm	730103	13-688-001
ME4C NT	70mbar	2.5 cfm	731203	13-688-913

Next-Generation Precision Weighing

The New XPR and XSR Precision Balances

Building on the success of the XPE balance line, the XPR features a large, vibrant color touchscreen with a redesigned user interface. The XSR, successor to the XS balance line, boasts multiple interface options and method parameters.

Visit fishersci.com/mettlertoledo or fishersci.ca/mettlertoledo to learn more and join the next generation of precision weighing



METTLER TOLEDO

Safe Containment

PLAS LABS, INC.

Plas Labs Laboratory Enclosures

Basic Glove Box, Model 818

- Simple enclosures for general isolation or containment work
- Compact, portable, lightweight, and easily moveable
- Modify with optional accessories (sold separately)

PCR Chamber, Model 825

- Front panel protects against beta radiation and 32P-labeled compounds
- Two acrylic shelves
- UV (decontamination) and fluorescent lamps

Compact Glove Box, Model 830-CP

- For weighing hazardous materials
- Removeable top section for easy access; no transfer chamber
- Two purging gas valves; replaceable HEPA and organic vapor canister filters
- Includes white ambidextrous Hypalon gloves



Description	Model	Dimensions (W x H x D)	Cat. No.
Basic Glove Box	818	55 x 38 x 35 in. (140 x 97 x 89cm)	11-389
PCR Chamber	825	24 x 17 x 18 in. (61 x 71 x 46cm)	11-386-135
Compact Glove Box	830-CP	49 x 31 x 30 in. (125 x 79 x 76cm)	11-386-138

Accurate, Sophisticated, Professional Weighing



OHAUS Explorer Semi-Micro Balances

OHAUS Explorer Semi-Micro Balances offer the features and value of flagship OHAUS Explorer Balances, plus readability of 0.01mg.

- Semi-micro readability for high accuracy
- Stability maintained quickly; can be used without weighing tables
- Automatic doors* offer access when hands are full and reduce contamination
- Built-in ionizer* removes static charges

*Select models only



Model	Capacity	Readability	Mfr. No.	Cat. No.
EX125	120g	0.01mg	30139511	01-919-371
EX125D	51g; 120g	0.01mg; 0.1mg	30139510	01-919-370
EX225D	120g; 220g	0.01mg; 0.1mg	30139512	01-919-372
EX225D/AD	120g; 220g	0.01mg; 0.1mg	30139513	01-919-373
EX225/AD	220g	0.01mg	30139514	01-919-374

AD: Automatic Door
D: Dual-Range

Get Consumables with Purchase



Sartorius arium Water Purification Systems

The Sartorius arium mini is a compact water purification unit, ideal for supplying up to 10L of ultrapure water daily. Reliable and user-friendly, the units feature intuitive operator guidance, a closed bag system, and practical leak protection.

For a limited time, purchase an arium mini or mini plus and get your first set of consumables at no additional cost:

- Pre-treatment cartridge: removes Cl₂, heavy metal ions, and particulate contaminants
- 5L bag: reduces cleaning time
- Scientific pack: removes organic and inorganic solutes with polishing cartridge
- Sterile filter: removes particles larger than 0.2µm



Excludes healthcare customers. See page 48 for full details.

Description	Water Type: Flow Rate	Mfr. No.	Cat. No.
arium mini	Type 1: 1L/min.	H2OMMTUS	14-559-040
arium mini with UV Irradiation	Type 1: 2L/min.	H2OMMUVTUS	14-559-041
arium mini plus	Type 1: 1L/min. Type 3: 8L/hr.	H2OMATUS	14-559-042
arium mini plus with UV Irradiation	Type 1: 2L/min. Type 3: 8L/hr.	H2OMAUVTUS	14-559-043

Description	Media or Material	Mfr. No.	Cat. No.
Pre-Treatment Cartridge*	Catalytic Activated Carbon	H2OCPR	14-559-044
Scientific Pack*	Catalytic Activated Carbon and Mixed-Bed Ion-Exchange Resin	H2OSPACK	14-559-045
Sartopore 2 Filter, 150 ME*		41307H4CE	14-557-601
5L Storage Bag*	S71, 6-Layer High Gas Barrier Film	H2OCBS5S	14-559-047
CellPlus Ultrafilter, for Endotoxin Removal	Polysulfone Membrane	H2OCUF	14-559-048

*Part of consumables offer

Maximize Your Hotplate



Heidolph Magnetic Stirring Hotplates

Heidolph Magnetic Stirring Hotplates

Choose a premium magnetic stirring hotplate and then maximize it by adding any of the convenient available accessories.

- Hermetically sealed housing protects all mechanical and electronic components
- Fire-resistant, die-cast housing
- Three-year warranty



13-889-335

Description	Controls/Display	Mfr. No.	Cat. No.
MR Hei-Standard	Analog	036110519	13-890-120
MR Hei-Tec	Digital	036110550	13-889-335
Hei-Connect Hei-Plate	Digital	036110601	13-889-382
MR Hei-End	Digital	036110580	13-889-336

Heat-On Blocks

The safest, fastest, and most efficient way to heat and stir round-bottom flasks (in sizes from 10mL to 5L).



Description	Mfr. No.	Cat. No.
Heat-On 1L	015882080	05-404-164
Heat-On 3L	015882100	05-404-166
Heat-On 5L	015882300	05-404-186

Findenser

Affordable and green, the Findenser now replaces traditional water condensers — no more flooded labs. Available in regular and mini sizes.



Description	Mfr. No.	Cat. No.
Super Air Findenser	015610000	13-889-550

Carousel

The patented Carousel 6 Plus Reaction Station simultaneously heats, stirs, and refluxes multiple samples under an inert atmosphere. Holds round-bottom flasks (sizes 5, 10, 25, 50, 100, 170, and 250mL).



Description	Mfr. No.	Cat. No.
Carousel 6 Plus Heated	015850400	13-889-503

Controlling Vacuum Levels Just Got Easier



KNF SC920 Programmable Vacuum Pump System

Control and monitor your process from anywhere in the lab.

This vacuum system provides a new level of control and performance for your vacuum applications. It features a wireless remote control unit that operates the pump wherever needed — on the bench or under the hood. This space-saving, high-performance system is also safe and easy to control.

Four easy-to-use operating modes:

Evacuation Mode — Adjust the speed of the pump from 15 to 100% to fit the needs of your specific application.

Pressure Control Mode — Set the pump speed to your programmed setpoint to eliminate bumping.

Automatic Setpoint Detection Mode — Your SC920 automatically detects and records the vapor pressure of the solvent and the setpoint. Press a button and walk away — the system does the rest.

Function Mode — Program the system to perform a series of steps or follow a specified pump-down curve. Function mode improves repeatability when handling multiple samples.

Provides consistent results and frees you up to get more done.

- Work quietly with the smooth-running, oil-free vacuum system
- Control everything from up to 60 feet away with the intuitive remote
- Monitor your process without opening the sash
- Connect to any Windows PC via SC920 USB port

Includes: Microsoft Windows-based software, USB interface to PC



13-880-90

Specifications	
Flow Rate	20L/min.
Vacuum	1.5 torr (2mbar)
Control	Wireless Remote, Windows Based
Power/Current Consumption	135w/1.7A
Hose Connection, Pneumatic	3/8 in. I.D. (10mm)
Hose Connection, Coolant	5/16 in. I.D. (8mm)
Net Weight	33 lb. (15kg)
Dimensions (L x W x H)	11.6 x 14.4 x 16.7 in. (29.4 x 36.6 x 42.3cm)

Description	Electrical Requirements	Mfr. No.	Cat. No.
Vacuum Pump System	120V 60Hz	SC920	13-880-90
Optional Coolant Valve		117121	13-880-951

Ductless Chemical Workstations Laminar Flow Workstations



Combination PCR Workstation

The AirClean Systems Combination PCR Workstation combines an ISO 5/Class 100 Clean Air Environment with UV light sterilization for optimal protection from sample contamination. A UVtect microprocessor constantly monitors workstation functions.

Standard Features:

- Class 100 clean vertical laminar flow air
- Polycarbonate and polypropylene design to reflect UV energy
- Digital UV light timer: 0 to 59 minutes
- UV shelf with integral pipette holder

PCR Workstation	Cat. No.
AC632LFUVC 32" PCR Workstation	36-101-8894
AC648LFUVC 48" PCR Workstation	36-101-8897



Endeavour Ductless Fume Hood

The Endeavour Ductless Fume Hood is designed to provide superior operator protection from potential toxic fumes, vapors, and particulates. AirSafe NXT provides simple and effective user interaction with fume hood operational parameters.

Standard Features:

- Microprocessor controller with audible and visible alarms for both airflow velocity and filter change
- Bonded carbon filters — no dust!
- Polypropylene construction — excellent chemical resistance

Endeavour Ductless Fume Hood	Cat. No.
ACPT4000 48" Ductless Fume Hood	36-100-0063
ACPT5000 60" Ductless Fume Hood	36-100-0067
ACPT6000 72" Ductless Fume Hood	36-100-0069

Filters sold separately; application worksheet required.

AC600 Series Ductless Chemical Workstation

The AC600 Series Ductless Chemical Workstation is an economical solution for protection of the operator and environment from toxic vapors, gases, fumes, and particulates. Ships fully assembled and can be configured in a variety of common applications.

Standard Features:

- Microprocessor controller has audible and visible alarms for both airflow velocity and filter change
- 360° visibility
- Ideal for low-volume chemical applications

Description	Cat. No.
AC632A 32" Workstation	36-100-4271
AC632TA 32" Workstation, Tall Version	36-100-4272
AC648A 48" Workstation	36-100-4274
AAC648TA 48" Workstation, Tall Version	36-100-4275

Filters sold separately, application worksheet required.



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CORNING

Corning Glassware, Hot Plates, and Stirrers

Exceptional strength and stability. Brilliant transparency. Superior resistance to chemicals, contaminants, and drastic changes in temperature. These are among the key properties that enable PYREX glass to endure even the toughest laboratory environments, making it the indispensable partner for chemists and research scientists for more than 100 years.

Equally tough is Corning constant-temperature equipment with unique Pyroceram surfaces. The durable hot plates and stirrers are the ideal complement to long-lasting PYREX glassware.



Hot Plates and Stirrers

Model	Description	Surface Dimensions	Mfr. No.	Cat. No.
Hot Plates				
PC-400D	Hot Plate, Digital Display	5 x 7 in.	6795400D	11-500-152
PC-200	Hot Plate, Analog	4 x 5 in.	6795200	11-497A
PC-170	Scholar Hot Plate	5 x 5 in.	6795170	13-641-564
Stirrers				
PC-410D	Magnetic Stirrer, Digital Display	5 x 7 in.	6795410D	11-500-154
PC-210	Magnetic Stirrer, Analog	4 x 5 in.	6795210	11-497-3A
PC-171	Scholar Magnetic Stirrer	5 x 5 in.	6795171	11-497-22

PYREX Beakers

Capacity	Mfr. No.	Cat. No.	Quantity
10mL	100010	02-540C	48/Case
20mL	100020	02-540E	48/Case
30mL	100030	02-540F	48/Case
50mL	100050	02-540G	48/Case
100mL	1000100	02-540H	48/Case
150mL	1000150	02-540J	48/Case
250mL	1000250	02-540K	48/Case
400mL	1000400	02-540L	48/Case
600mL	1000600	02-540M	36/Case
1L	10001L	02-540P	24/Case

PYREX Erlenmeyer Flasks

Capacity	Mfr. No.	Cat. No.	Quantity
25mL	498025	10-040B	48/Case
50mL	498050	10-040C	48/Case
125mL	4980125	10-040D	48/Case
250mL	4980250	10-040F	48/Case
500mL	4980500	10-040H	36/Case
1L	49801L	10-040K	24/Case



LIFE SCIENCES

Will GMO Labeling Change Buying Habits?

By Lynne Lescott

Food manufacturers have until 2020 to comply with a U.S. federal law that requires products containing genetically modified organisms (GMOs) to be clearly labeled. It's a development many consumer advocates claim as a victory, but whether it will produce meaningful change remains to be seen.

From Diabetes to Denim

Products made with materials from GMOs are not especially new or unusual. Human insulin produced by GMOs, which was the first medical product approved by the FDA (1980), is routinely prescribed for people with diabetes. The insulin created through GMOs has significantly reduced treatment costs and eliminated the adverse effects of using porcine insulin.

Other non-food GMO products include the cotton in our blue jeans, the multivitamins in our medicine cabinets, and the stain-lifting laundry detergent in our washing machines. More than forty years ago, a variety of consumer groups and others protested the FDA's approval of GMO insulin, a reaction echoed by the lobbying efforts of today's consumer groups that support labeling foods that contain GMOs. Voices from organic-lifestyle groups have also been raised in opposition to GMO-

derived clothing and products that are not required to carry GMO labeling.

Hardy Crops

For more than 20 years, crops have been bioengineered to produce certain desirable characteristics; the resulting plants repel destructive pests or resist the effects of herbicides and other chemicals. The genetic modifications conducted in the lab are precise and measured, and outcomes are predictable and repeatable.

Modified food ingredients are now found in an estimated 60 to 70% of processed foods in the U.S., including those that appear on the shelves of grocery stores. Potato chips, soup, cereal, soda, and many other processed foods include GMO-derived ingredients from corn, soybeans, canola, sugar beets, potatoes, and other GMO crops.

GMO Label Facts

The new rules that go into effect in 2020 require food products to be labeled as "GMO" only if the primary ingredient is GMO-derived. Foods may not be labeled if only secondary ingredients contain GMOs, and the labels won't explain how or why the food was modified.

The U.S. Department of Agriculture is still developing acceptable GMO label components, but three labeling options are likely:

- A GMO disclosure statement
- A new bioengineered (BE) icon
- A quick response (QR) code that takes users to a website with more information

Some manufacturers of non-GMO products currently label products as GMO free. Meanwhile, some industry experts suggest that labels on GMO-free products like oats, which have no GMO equivalents, could mislead consumers about the benefits of those foods.

Will We or Won't We?

Heightened awareness of GMOs does not change the fact that foods containing GMOs have not been shown to have negative effects or cause harm to humans or animals. Still, the question remains: how will Americans respond to GMO labels? Neither shoppers, nor food manufacturers, nor GMO activists pro or con are ready to predict whether shopping behaviors are likely to change, or by how much.

Products for Molecular Biology Labs



Decon Labs Ethanol and ELIMINase

Ethanol

Effectively precipitate DNA and RNA from samples with Decon Ethanol for Molecular Biology.

- 200 Proof (100%)
- Can be used full strength or diluted with nuclease-free water
- Tested: free of RNase and DNase endonucleases

Description	Mfr. No.	Cat. No.	Quantity
Ethanol, 8.5 oz.	3916EA	07-678-003	Each
	3916	07-678-002	24/Case

ELIMINase

Instantly remove RNase, DNase, unwanted DNA, and radioactive contamination from labware and equipment with Decon ELIMINase Decontaminant.

- Eliminates the need for autoclaving or using DEPC
- Non-toxic, safe, and effective
- Ready-to-use

Description	Mfr. No.	Cat. No.	Quantity
ELIMINase, 8.5 oz.	1101	04-355-31	Each
			12/Case
ELIMINase, 32 oz.	1102	04-355-32	Each
			12/Case



Increase Transduction Efficiency

Mirus Bio *TransIT*-Lenti Transfection Reagent

Mirus Bio *TransIT*-Lenti Transfection Reagent is designed to enhance delivery of packaging and transfer vectors to adherent HEK 293T and suspension 293-F cell types for increased recombinant lentivirus production. It produces higher functional titers for effective transductions with a single harvest — no media change required.

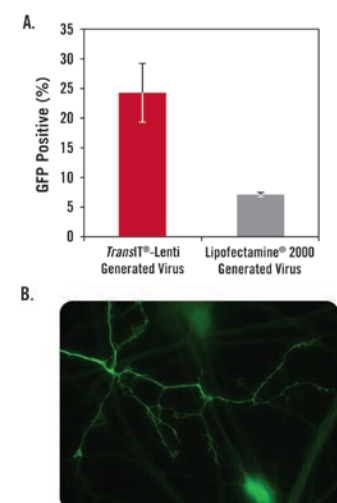
In a recent study, lentivirus was produced using the Mirus Bio *TransIT*-Lenti or Invitrogen Lipofectamine 2000 Transfection Reagent to transfect the Lentivirus Packaging Mix Powered by Sigma-Aldrich MISSION. The supernatant was harvested, filtered, and frozen. Lentivirus transductions were performed five days post-plating of Cellular Dynamics International iCell Motor Neurons using one microliter of each unconcentrated virus supernatant prep per well of a 96-well plate.

GFP images and efficiency were assessed 72-hours post-transduction, and fivefold higher transduction efficiency was observed in iCell Motor Neurons transduced with lentivirus produced using *TransIT*-Lenti Transfection Reagent.

Description	Mfr. No.	Cat. No.	Quantity
<i>TransIT</i> -Lenti Transfection Reagent	MIR 6603	MIR6603	1 x 0.3mL
	MIR 6604	MIR6604	1 x 0.75mL
	MIR 6600	MIR6600	1 x 1.5mL
	MIR 6605	MIR6605	5 x 1.5mL
	MIR 6606	MIR6606	10 x 1.5mL

Visit fishersci.com/mirusbiosample to try it for yourself.

Excludes healthcare customers. See page 48 for details.



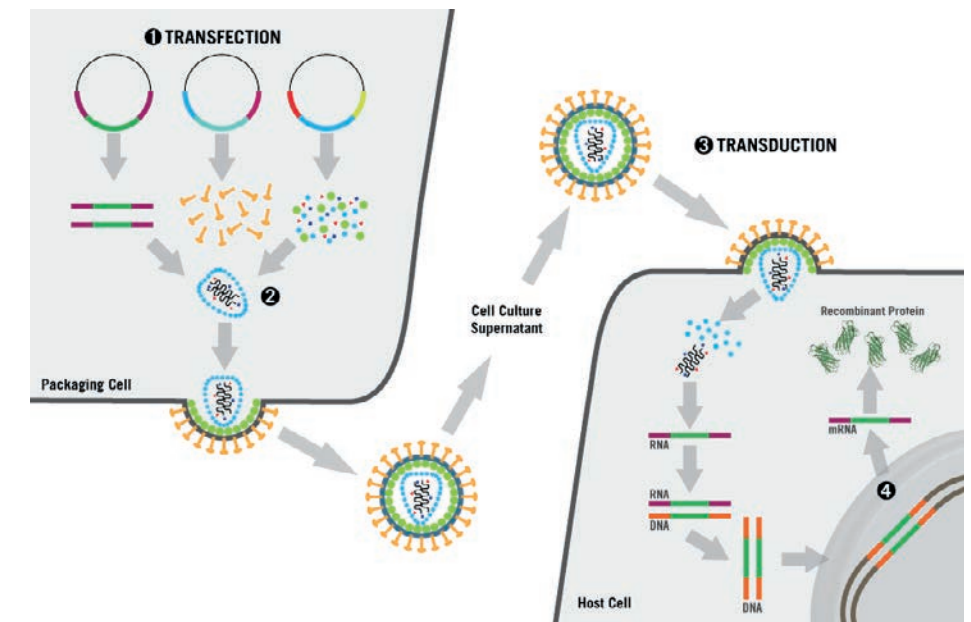
Optimizing Lentivirus Production

Lentivirus is an integrative retrovirus that consists of a single-stranded RNA genome, a reverse transcriptase, and a viral envelope. The best known lentivirus is the Human Immunodeficiency Virus (HIV), which causes AIDS. Lentivirus has the ability to integrate with the DNA of both dividing and non-dividing host cells. Integration of viral genetic material can occur in host cells of humans and other mammals, and the modified DNA can then be inherited by the host's descendants.

Lentivirus technology has become an efficient tool to deliver exogenous genes into various types of *in vitro* and *in vivo* cells. To produce lentivirus, HEK 293 cells are transfected with plasmids encoding the required *gag*, *pol*, and *rev* structural and regulatory genes, and a transfer vector encoding the gene of interest (GOI). Replication incompetence is achieved by expressing the minimal virus components on separate plasmids and incorporating the self-inactivating (SIN) elements through a major deletion of the 3' long terminal repeat (LTR) within the transfer vector.

Effective Transfection Reagents

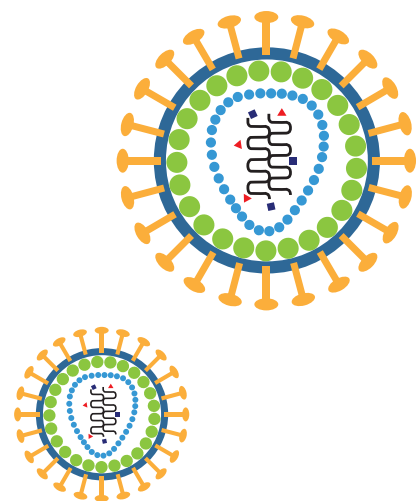
Although relevant across multiple applications, the lentivirus platform can be limited by insufficient functional viral titers, which then requires sample concentration before use in target cells. To address this limitation, Mirus Bio developed *TransIT*-Lenti Transfection Reagent for enhanced delivery of the essential vectors required for higher-titer functional lentivirus production in both suspension and adherent HEK 293 cell types. With *TransIT*-Lenti, greater than twofold higher functional titers are achieved over competing transfection reagents. No change of media is required, and virus can be gathered in a single harvest 48 hours after transfection.



Overview of Recombinant Lentivirus Particles and Target Cell Infection

1. Producer cells are transfected with three to four plasmids encoding the gene of interest, vesicular stomatitis G protein (VSV-G), and essential virus proteins (*gag*, *pol*, and *rev*).
2. Virus is assembled and released into the supernatant through budding, resulting in an envelope decorated with VSV-G. The medium is filtered to remove any cells.
3. Target cells are frequently transduced with recombinant lentivirus particles. The virus enters the cell and the capsid uncoated to reveal the RNA genome and viral enzymes. The viral RNA is reverse transcribed into DNA, which is then integrated into the host genome to produce a stable cell line.
4. Transcription and translation result in constitutive protein production as encoded by the gene of interest.

Content provided by:

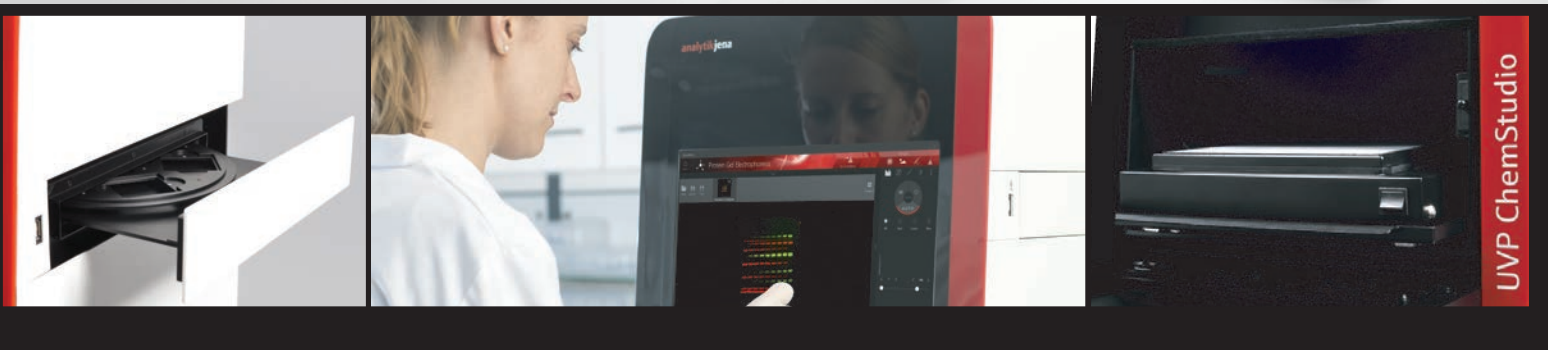


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- Features a 13.3 in. integrated touchscreen monitor, fold-down door, and Thin-Line Transilluminator on a slideout tray

Description	Camera & Lens	Software Control	Mfr. No.	Cat. No.
UVP ChemStudio <i>touch</i>	8.1MP, f/0.95	Integrated touchscreen	849-97-0928-01	84-997-092801
UVP ChemStudio	8.1MP, f/0.95	PC-controlled	849-97-0928-03	84-997-092803


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secondary, and
custom antibodies
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relationships



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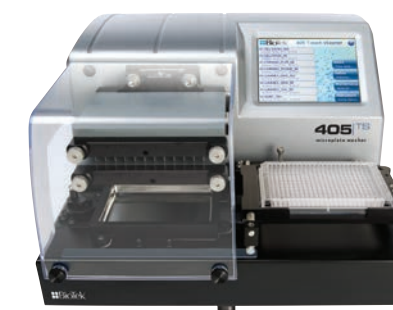
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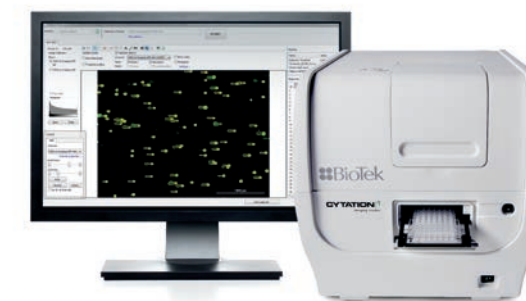
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Model	Description	Cat. No.
Synergy LX	Absorbance, Fluorescence, and Luminescence with Touchscreen UI; Includes Gen5 Software	BTSLXFATS
405 TS	96-/384-Well Microplate Washing, Ultrasonic Advantage, Buffer Switching	BT405TSUVSP
800 TS	For 6- to 96-Well Plates; Detection Range: 400 to 750nm	BT800TSPM
Cytation 1	Fluorescence and High-Contrast Brightfield Imaging; Includes Gen5 Software	BTCYT1V

Catalog numbers shown may not reflect all product features listed. Contact your Fisher Scientific sales representative to learn more about other available configurations.

The Best Methods for Metagenomic Sample Prep

FastDNA Spin Kits for Soil and FastRNA Pro Soil Kits, used in combination with a FastPrep instrument, deliver the highest DNA and RNA yields from environmental samples, including soil, sediments, sludge, compost, manure, the rhizosphere, waste water, building materials, and feces. The kits include Lysing Matrix tubes and reagents to extract DNA and RNA using methods that efficiently remove humic acids and other PCR inhibitors.

Harada et al.^A demonstrated that the FastDNA Spin Kit for Soil is the method of choice (compared to similar products) for detecting and quantifying parasites in patient fecal samples. Even low concentrations of *K. septempunctata* (1.6×10^1 spore/g of feces) were detected by real-time PCR after purification using the FastDNA SPIN Kit for Soil.

The FastDNA Spin Kit for Soil was shown by Ettenauer et al.^B to be the gold standard method for quantifying indoor fungi and bacteria in building materials. From an evaluation of 13 methods, the FastDNA Spin Kit for Soil demonstrated the best results for the three building materials tested. DNA was not only successfully isolated from each material, but its quality surpassed that of the other methods.

Preparation of environmental samples that completely lyse all organisms, including eubacterial spores, gram positive bacteria, yeast, algae, nematodes, and fungi can be performed within seconds with FastPrep instruments.

The FastPrep-24 5G Instrument is a high-speed benchtop reciprocating homogenizer offering the ultimate in speed and performance for the optimal lysis of biological samples. Developed for difficult and resistant samples, the FastPrep-24 5G thoroughly and quickly grinds and lyses any tissue and cells, providing reproducible isolation and purification of stable RNA, active proteins, and full-length genomic DNA.

The FastPrep-24 5G is software-controlled, designed with a user-friendly touchscreen and unique features of the highest speed and power with the shortest processing times and over 70 pre-programmed protocols optimized for the needs of your application.

The FastPrep-96 instrument delivers high-throughput sample homogenization and lysis with the highest efficiency and reproducibility. A completely self-contained system, the FastPrep-96 uses a vigorous, linear, vertical motion to thoroughly disrupt up to 192 samples through the simultaneous beating of specialized lysing matrix particles.

Designed for two 2mL lysing matrix tubes, the SuperFastPrep-2 Instrument is a portable omni-directional bead beating system with a unique, patent-pending balanced crankshaft-slider mechanism that generates efficient sample homogenization.

MP Biomedicals offers solutions for other research applications from low- to high-throughput scale with a selection of homogenization instruments, lysing matrix tubes, and complete purification kits.

Content provided by:



A. Harada T. (2012) *Journal of Clinical Microbiology*. 50: 2964.
B. Ettenauer J.D. (2012) *Science of the Total Environment*. 439: 44

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For researchers performing gene expression who need an intuitive and easy-to-use qPCR solution, the Applied Biosystems QuantStudio Real-Time PCR Systems combined with either our SYBR Green Master Mix or Applied Biosystems TaqMan Master Mix bundles offer exceptional specificity with the speed and ease of use of Cloud connectivity.

QuantStudio 3 qPCR System and SYBR Green Master Mix Bundle

- QuantStudio 3 qPCR System, 96-Well, 0.1mL, Laptop
- SuperScript IV VILO Master Mix with ezDNase (50 rxns)
- PowerUp SYBR Green Master Mix (5 x 5mL)
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- MicroAmp Optical Adhesive Film (100 covers)

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QuantStudio 3 qPCR System and TaqMan Master Mix Bundle

- QuantStudio 3 qPCR System, 96-Well, 0.1mL, Laptop
- SuperScript IV VILO Master Mix with ezDNase (50 rxns)
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QuantStudio 5 Real-Time PCR System, 96-Well and TaqMan Master Mix Bundle

- QuantStudio 5 qPCR System, 96-Well, 0.1mL, Laptop
- SuperScript IV VILO Master Mix with ezDNase (50 rxns)
- TaqMan Fast Advanced Master Mix (5 x 5mL)
- MicroAmp Fast Optical 96-Well Reaction Plate, 0.1mL (10 plates)
- MicroAmp Optical Adhesive Film (100 covers)

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QuantStudio 5 Real-Time PCR System, 384-Well and TaqMan Master Mix Bundle

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- SuperScript IV VILO Master Mix with ezDNase (50 rxns)
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Finding the Right Cryostat

Multiple factors affect your decision to purchase a specific cryostat, and this overview of features and options may help you find the equipment best suited to your applications.

Temperature Control

Consistent sample temperature provides reliable section quality, and cryostats have various cooling mechanisms:

- Chamber cooling is most common; be aware that temperatures fluctuate when the chamber door is open
- Models that cool both the chamber and the sectioning surface help to maintain temperature stability and optimal section quality

Sectioning Quality

- A vacutome creates a gentle air tunnel under the anti-roll plate during sectioning to help with curling — a common challenge with frozen sectioning
- Choose quality blades to maximize your cutting performance and to achieve faster ribboning, increased longevity, and reliable consistency

Ease of Use

- If the user will be sectioning for long periods of time, choose a cryochamber with adjustable height to ensure proper ergonomics
- Motorized sectioning is often an option and may be helpful, especially for very repetitive or extended sectioning

Disinfection

- UV light disinfection effectively protects users against surface contamination
- Cold disinfection is available with some units: the cold cryochamber is filled with a nonhazardous hydrogen peroxide-based fog to quickly, safely, and thoroughly disinfect even areas missed by the UV light



Mechanical Systems and Maintenance

- Traditionally, cryostats have been cooled using single- or dual-compressor systems
- Some newer models offer a Peltier-based cooling system for faster response times, greater energy efficiency, and lower compressor maintenance costs



The Thermo Scientific CryoStar NX Family of Cryostats

Unmatched sectioning quality, ergonomics, and safety are available in three models to fit your budget and applications.

They offer:

- Optimized sectioning quality — new design and rapid response temperature control
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Unsurpassed strength and chemical protection with ultimate tactile sensitivity.

Properly contoured, easy-donning glove for long-wearing comfort you can count on

Excellent resistance to common laboratory chemicals

Tensile strength DOUBLE the ASTM minimum requirement

300-count box maximizes space, reduces waste, and minimizes cost

Size	Mfr. No.	Cat. No.	Quantity
X-Small	300	18-041-140	3,000/Case
Small	301	18-041-141	3,000/Case
Medium	302	18-041-142	3,000/Case
Large	303	18-041-143	3,000/Case
X-Large	304	18-041-144	2,500/Case

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Size	Mfr. No.	Cat. No.	Quantity
X-Small	700	17-900-912	3,000/Case
Small	701	17-900-913	3,000/Case
Medium	702	17-900-914	3,000/Case
Large	703	17-900-915	3,000/Case
X-Large	704	17-900-916	2,500/Case

*Patent LowDerma.com/patents

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High-Tech Sports Equipment Targets Head, Heart Injuries

By Kevin Ritchart

As athletes continue to get bigger, stronger, and faster, sports equipment manufacturers are doing their best to keep pace with the increasing demand for effective protection from traumatic injuries.

Each year, more than 10 percent of the 30 million children who participate in sports sustain some type of injury. Companies that manufacture sports safety equipment are continually making advancements in helmets, pads, eye protection, and other equipment to offer additional safety measures and keep up with demand.

On the Field

While sports safety is a growing concern, very few companies have the resources to be successful. When it comes to technology, research and development, and overall strategy, Riddell has established itself as a leader. The company's football helmets account for 65 percent of those used by NFL players and 90 percent of NCAA Division 1 players.

In 2013, Riddell debuted the InSite Impact Response System, an in-helmet sensor technology that monitors the severity of impacts and wirelessly

transmits the results to the coaches on the sideline when the severity of a hit (or the accumulation of multiple hits) exceeds a predetermined threshold.

Rather than wait for word of this new technology to spread on its own, Riddell dispatched over 300 salespeople throughout the U.S. and Canada to work with coaches, equipment managers, trainers, and school administrators to show them firsthand how the product could make football safer for their players.

In the Lab

In 2011, Virginia Tech University established a "Helmet Lab" that provides unbiased ratings of helmets to help customers make informed purchasing decisions. The helmet ratings, which are the result of more than a decade of peer-reviewed research on head trauma in sports, identify the helmets that most effectively reduce the risk of head injuries. Researchers create testing conditions that mimic the types of impacts players are likely to experience in high school and college games.

Sensors are embedded in a test-dummy head to record the linear and rotational

acceleration resulting from various impacts, and those results are used to calculate a STAR value. The STAR value indicates how much each helmet reduces the head's acceleration, which translates to a lowered risk of head injury. The more stars a helmet earns, the better it is at reducing injury risk. The VICIS ZERO1 helmet earned five stars, the top 2018 rating from the Virginia Tech Helmet Lab.

From the Head to the Heart

While football is typically the first sport to be mentioned when it comes to sports injuries, a company called Unequal has focused its efforts on the diamond. The leading cause of death for youth baseball players is *commotio cordis*, which is a disruption of the heartbeat resulting from blunt trauma to the chest.

Unequal created the HART Chest Protector using Kevlar, the same material used in bulletproof vests, to respond to the impending *commotio cordis* protection mandate from the National Federation of High Schools that will go into effect in January 2020.

Quality and Durability

DuPont Shoe and Boot Covers



ProShield 30 Shoe Covers

- Spunbond PP; resistant to liquids
- Lint free; seamless
- Skid-resistant sole; elastic ankles

Tyvek IsoClean Shoe Covers

- Particle, microorganism, and light liquid splash barrier
- Enhanced skid resistance and durability
- Serged seams; elastic opening

ProShield 30 Boot Covers

- Sterile material and construction
- Spunbond PP with PE coating
- Resists delamination, linting
- Serged seams; elastic opening



Description	Color	Size	Cat. No.	Quantity
ProShield 30 Shoe Covers	Blue	Large	19-047-744	100/Case
	Blue	X-Large	19-047-745	100/Case
	White	Large	19-045-450C	100/Case
	White	X-Large	19-088-2235	200/Case
ProShield 30 Boot Covers	White	Medium	19-045-452C	200/Case
	White	Large	19-080-722C	100/Case
	White	X-Large	19-080-722D	50/Case
Tyvek IsoClean Shoe Covers	White	Medium	17-988-087	100/Case
	White	Large	17-988-086	100/Case
	White	X-Large	17-988-150	100/Case

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- Available in a standard lightweight plain weave or a premium heavier weight twill

Catalog Numbers (All Sizes Men's Regular)

	X-Small	Small	Medium	Large	X-Large
STANDARD	19-823-606	19-823-607	19-823-608	19-823-609	19-823-610
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Fisherbrand Disposable Gloves come in your choice of nitrile or latex, with or without aloe, and in a range of colors, textures, thicknesses, and sizes. These gloves are nonsterile, ambidextrous, and powder free.



Description	Cuff Length	Thickness Palm (Fingers)	Color (Texture)	Sizes	Cat. No.	Quantity
Nitrile Exam Gloves	9.5 in.	3mil (4.3)	Blue (Full)	X-Small to 2X-Large	19-130-1597A to 19-130-1597F	1,000/Case
Comfort Nitrile Exam Gloves	9.5 in.	3mil (3.5)	Periwinkle Blue (Fingers)	X-Small to X-Large	19-041-171A to 19-041-171E	2,000/Case*
Black Nitrile Exam Gloves	9.5 in.	3.5mil (5.5)	Black (Fingers)	X-Small to 2X-Large	19-156-300, 19-181-603 to 19-181-607	1,000/Case
Dark Blue Nitrile Exam Gloves	9.5 in.	4.7mil (5.5)	Cobalt Blue (Full)	Small to X-Large	19-181-608 to 19-181-611	1,000/Case
Nitrile Exam Gloves, Extended Cuff	12 in.	6mil (7.0)	Teal (Full)	Small to X-Large	19-041-170A to 19-041-170D	500/Case
Nitrile Exam Gloves with Aloe	9.5 in.	5.5mil (6.0)	Green (Full)	Small to X-Large	19-050-550A to 19-050-550D	1,000/Case
Comfort Nitrile Exam Gloves with Aloe	9.5 in.	3.1mil (3.9)	Blue Green (Full)	X-Small to X-Large	19-041-172A to 19-041-172E	1,000/Case
Comfort Nitrile Exam Gloves with Aloe	9.5 in.	2.8mil (3.9)	Green (Fingers)	X-Small to X-Large	19-041-191A to 19-041-191E	2,000/Case
Latex Exam Gloves	9.5 in.	5mil (6.3)	Natural (Full)	Small to X-Large	11-394-5A to 11-394-5D	1,000/Case
Latex Exam Gloves with Aloe	9.5 in.	6mil (6.5)	Natural (Full)	Small to X-Large	19-050-548A to 19-050-548D	1,000/Case

*Size XL contains 180 Gloves/Box, 1,800/Case

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